Combined Magnetic Tweezers and TIRF microscopy to visualize DNA-protein interactions

SY07-07

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The combination of Magnetic Tweezers (MT) with TIRF microscopy allows the simultaneous correlation of mechanical measurements of biomolecules and direct visualization of DNA-protein interactions. The strength of combining these two techniques relies on the advantages they have separately. MT permit the tracking of several DNA molecules in parallel, while a force is applied in a controlled manner. TIRF microscopy exhibits a superior signal to noise ratio over other fluorescence-based techniques, with an evanescent field of a few hundreds of nm from the surface. The drawback is that long DNA molecules need to be stretched across the surface of the flow cell. Here, we present the implementation of a laterally pulling device and its subsequent calibration in flow cells and capillaries. TIRF microscopy was also implemented in this lateral Magnetic Tweezers setup and characterized using fluorescently labelled beads and quantum dots. DNA binding by the *B. subtilis* protein Spo0J/ParB was studied using the combined setup. Fluorescently labelled ParB proteins were able to bind non-specifically along DNA molecules producing a constant emission signal, consistent with the dynamic exchange of protein. Condensation of DNA by ParB was prevented using lateral pulling.